

First record of *Lepanthes appendiculata* Ames (Orchidaceae: Pleurothallidinae) from Nicaragua, with comments on the morphological variation, geographical distribution, and conservation status

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Abstract: *Lepanthes appendiculata* Ames, a new record for the orchid flora of Nicaragua is presented, with comments on its geographical distribution, floral variations, and analysis of conservation status following IUCN criteria. Additionally, we include iconography of its floral variations, habitats, and a detailed distribution map. Based on the herbarium records and iconography, we also accept and corroborate 10 species of *Lepanthes* Sw. in Nicaragua.

Key words: conservation; Honduras; Guatemala; Mexico; new record; IUCN

The genus *Lepanthes* Sw. (Orchidaceae, Pleurothallidinae) includes more than 800 species, ranging from southern Mexico through Central America and the Antilles to Bolivia and Brazil (Thoerle and Hirtz 2015). Species of *Lepanthes* are epiphytic or rarely epipetric plants, characterized by the racemose inflorescence and floral characteristics that include usually transversely bilobed petals and usually a tripartite lip with an appendix (Thoerle and Hirtz 2015). In Nicaragua between nine and 15 species and subspecies of *Lepanthes* have been reported; however, the exact number depends on which are ones accepted, the correctness of determinations, and whether species are confirmed by the presence of a voucher. Hamer (1983, 1984, 1985) recorded eight species and one subspecies, and Ossenbach et al. (2007) recorded 14 species and one subspecies, while van den Berghe and van den Berghe (2008) reported 13 species and one undetermined

species. The Flora de Nicaragua (last updated on 3 June 2009) reported 10 species (Tropicos 2015) and CITES (2010) 14 species (Table 1). However, some of the species totals above include synonyms, are based on misidentifications, or they lack authenticated herbarium specimens to scientifically confirm their presence in Nicaragua.

Table 1. Taxonomic and floristic treatments that include *Lepanthes* species for Nicaragua. + New record for Nicaragua. * (= *L. pristidis*). References. 1 = Hamer (1982, 1984, 1985). 2 = Ossenbach et al. (2007). 3 = Van den Berghe and van den Berghe (2008). 4 = Flora de Nicaragua, "Last modified on June 3, 2009" (Tropicos 2015). 5 = CITES (2010). 6 = This study.

Taxa	References					
	1	2	3	4	5	6
<i>L. appendiculata</i> Ames +						*
<i>L. acuminata</i> Schltr.		*	*	*	*	*
<i>L. acuminata</i> subsp. <i>ernesti</i> Salazar & Soto Arenas	*	*	*			
<i>L. blephariglossa</i> Schltr.					*	
<i>L. blepharistes</i> Rchb.f.	*	*	*	*	*	*
<i>L. costaricensis</i> Schltr.	*	*	*	*	*	*
<i>L. disticha</i> Garay & R.E.Schult. (*)	*	*	*			*
<i>L. edwardsii</i> Ames		*	*	*	*	*
<i>L. erinacea</i> Rchb.f.					*	
<i>L. eximia</i> Ames	*	*	*	*	*	*
<i>L. guanacastensis</i> Ames & C.Schweinf.	*	*	*	*	*	
<i>L. helleri</i> A.D.Hawkes	*	*	*	*	*	*
<i>L. jimenezii</i> Schltr.					*	
<i>L. johnsonii</i> Ames	*	*		*	*	
<i>L. oreocharis</i> Schltr.	*	*	*	*	*	*
<i>L. pristidis</i> Rchb.f.		*		*	*	
<i>L. rotundifolia</i> L.O.Williams					*	
<i>L. samacensis</i> Ames		*	*			
<i>L. stenophylla</i> Schltr.		*	*			*
<i>L. turialvae</i> Rchb.f.		*	*			*
<i>L. sp.</i>			*			

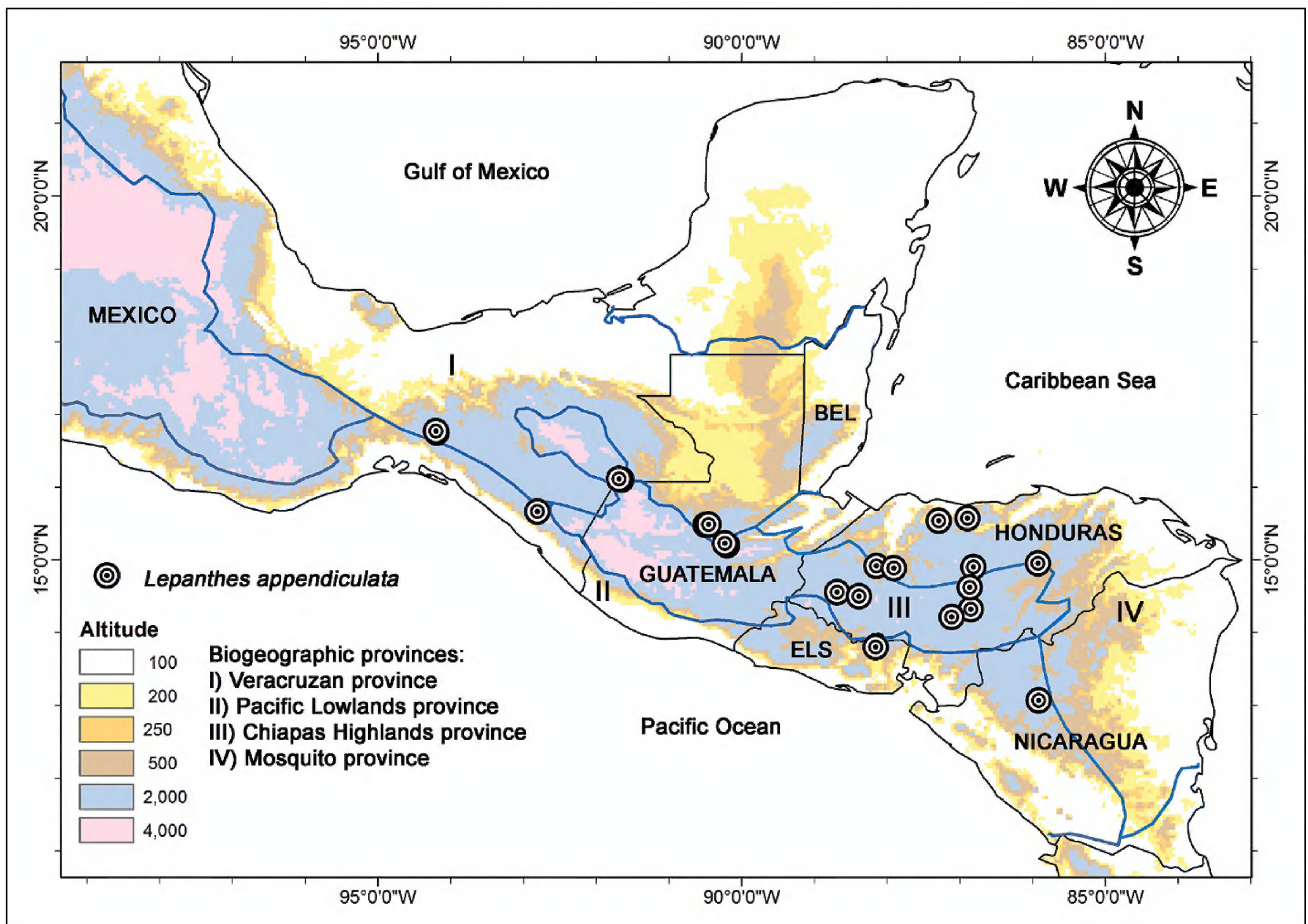


Figure 1. Distribution of *Lepanthes appendiculata*. Outlines of biogeographic provinces from Morrone (2014), based on vector layers of Löwenberg-Neto (2014).

For example, *Lepanthes disticha* Garay & R.E.Schult., cited as an accepted name in several studies (Table 1), is synonymous with *L. pristidis* Rchb.f.; *L. johnsonii* Ames, a species restricted to Guatemala and Mexico. The taxon not determined by van den Berghe and van den Berghe (2008) corresponds to *L. appendiculata*.

During fieldwork (1 August 2015) at the Reserva Natural Cerro El Arenal, Matagalpa state, in north-western Nicaragua, one of us collected a specimen of *L. appendiculata* (NCA 6, HULE) which represented the first record of this species in Nicaragua. Biogeographical distribution and eco-vegetation data are based on previous publications (Salazar Chávez and Soto Arenas 1996; Hamer 1998), herbarium collections, and specimens that we photographed in the field (Appendix 1). With these distribution data, we evaluated the conservation status of *L. appendiculata* following the criteria of IUCN (2014) and GeoCAT (Bachman et al. 2011). On the other hand, we recognize 10 species based on the drawings and/or photos of references cited in Table 1 and relevant herbarium specimens (Appendix 2).

Lepanthes appendiculata was previously reported from the southwest Mexico to northern Nicaragua, mainly in the province of Chiapas Highlands; and

between the lower reaches of Veracruz, Pacific Lowlands and Mosquito provinces (Figure 1). In Mexico, it occurs in the Oaxaca and Chiapas states where it is an epiphyte with *L. breedlovei* Salazar & Soto Arenas in high evergreen and pine-oak-Liquidambar forests at elevations of 1350–2500 m (Salazar Chávez and Soto Arenas 1996).

In Guatemala, *L. appendiculata* occurs in the provinces of Alta Verapaz (Cobán; Figure 2A, type specimen), San Juan Chamelco, and San Cristóbal Verapaz (Figure 2B). It is also found in San Pedro (Carcha municipality) and Baja Verapaz (Purulha municipality) (Figure 2B, 2C), as well as in Chiquimula, Huehuetenango, Jalapa, Jutiapa, Progreso and Zacapa. The species grows on the trees of *Clethra* sp., *Liquidambar styraciflua* L., *Persea donnell-smithii* Mez, *Magnolia guatemalensis* Donn.Sm. and *Quercus* sp. It is found in association with other orchids, such as *Lepanthes scopula* Schltr., *L. stenophylla* Schltr., *L. verapazensis* Archila, *Lepanthopsis floripecten* (Rchb.f.) Ames, *Stelis villosa* (Knowles & Westc.) Pridgeon & M.W. Chase, and *S. guatemalensis* Schltr. *Lepanthes appendiculata* occurs in wet forests and subtropical lower montane rainforests between elevations of 1100 and 2500 m.

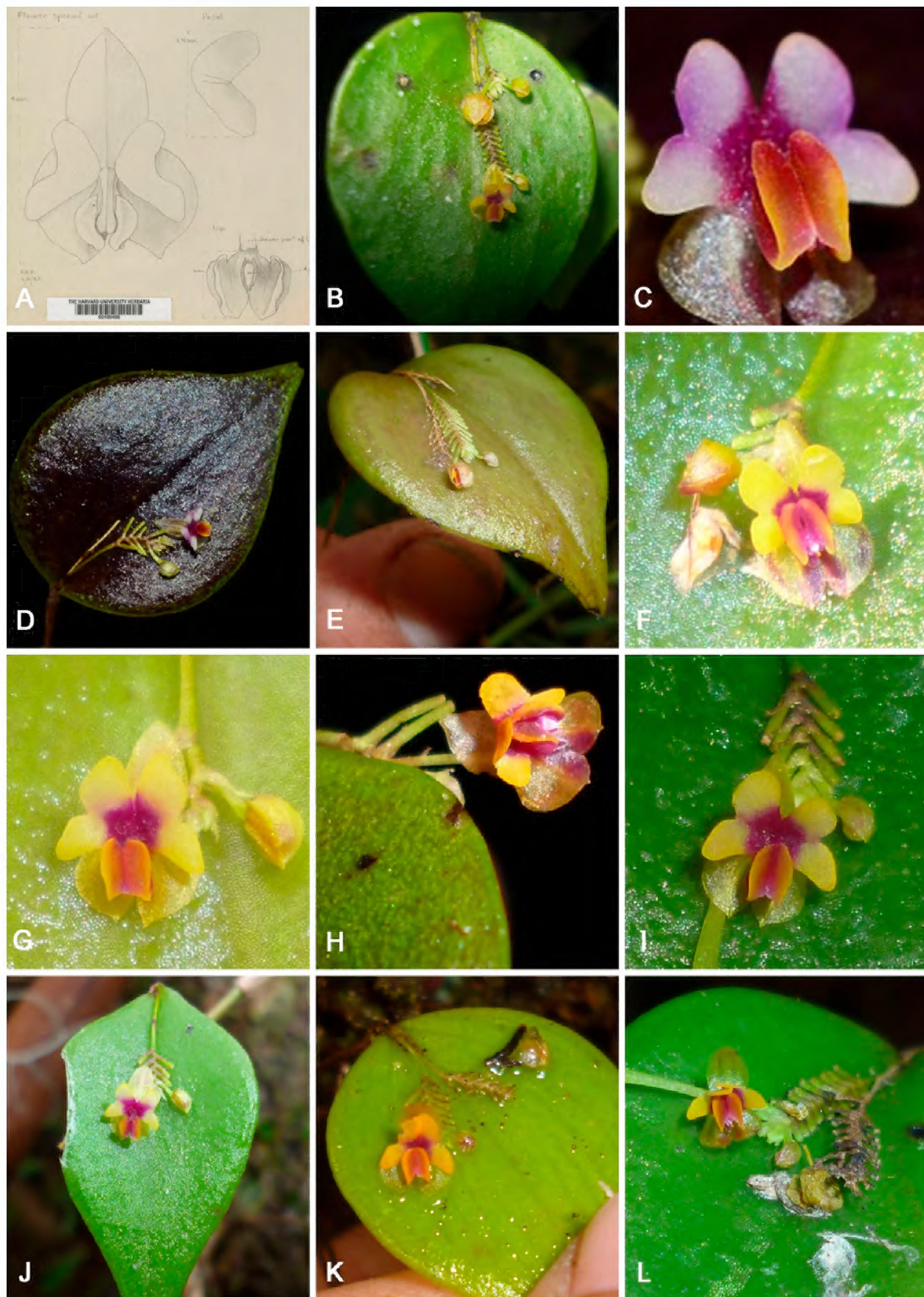


Figure 2. *Lepanthes appendiculata*. **A–D:** Guatemala; **A:** Drawing of holotype, details of the flower (Orchid Herbarium of Oakes Ames, Harvard University Herbaria (AMES), courtesy of G.A. Romero-González; **B:** R. Hernández s.n.; **C–D:** J. Monzón Sierra s.n.; **E–L:** Honduras; **E:** P. House & H. Vega s.n.; **F, G, I, J:** H. Vega s.n.; **H:** H. Vega 1447 (TEFH); **K:** H. Vega 1907 (TEFH); **L:** H. Vega & K. Romero 1798 (TEFH). Photos by R. Hernández (B), J. Monzón Sierra (C–D) and H. Vega (E–L).

In El Salvador, *L. appendiculata* has been reported growing in rainforests of the Morazán department at an altitude of 1800 m (Hamer 1974). In Honduras, this species is widely distributed in national parks and reserves along the central parts of the Atlántida (Pico

Bonito National Park, Texíguat Wildlife Refuge; Figure 2E), Comayagua (Cerro Azul Meámbar National Park; Figure 2F), Francisco Morazán (La Tigra National Park; Figure 2G), Misoco Biological Reserve (Figure 2H), Lempira (Celaque Mountain National Park; Figure 2I), and



Figure 3. *Lepanthes appendiculata*. New record for Nicaragua. **A–B:** Flowers, front view; **C:** Flower, lateral view; **D:** Flower with scale; **E:** Inflorescence; **F:** Leaf. Detail of the leaf. **G.** Habit. [Based on N. Cash-Arcia 6 (HULE)]. Photos by N. Cash-Arcía

Olancho (Sierra de Agalta National Park). Elsewhere, it is also known from the departments of Francisco Morazán (El Chile locality; Figure 2J), Intinbucá (San Francisco de Opalaca municipality; Figure 2K), Olancho (Juticalpa, El Armado; Figure 2L), and Santa Bárbara (Santa Bárbara municipality). In these places, it grows on oak trees (*Quercus* sp.) in cloud forests (between elevations

of 1100–2600 m) except in the eastern region of the Honduran Mosquitia.

Our collection is the first report of *L. appendiculata* from Nicaragua (Figure 3), where it was found in the Jinotega in Cerro Arenal Natural Reserve. There, it occurs along with *L. scopula*, *L. helleri* A.D.Hawkes and *Lepanthopsis floripecten* on the trees of *Cupania glabra* Sw. in the cloud



Figure 4. Habitats of *Lepanthes appendiculata*. **A–B:** Cloud forest in Guatemala; **C–D:** Cloud forest in Nicaragua; **E–F:** Subtropical lower montane rainforests in Guatemala. Photos by E. Mo (A-B, E-F) and N. Cash-Arcía (C-D).

forests between elevations of 1300–1500 m (Figure 4).

Lepanthes appendiculata is a morphologically variable species (Figures 2 and 3). The vegetative variation mainly involves the color (completely green [Figure 2B, 2F–2L] to green with reddish or purple spots [Figure 2D]) and leaf shape (cordate, obovate to ovate, ovate-lanceolate). However, this variation apparently is not

correlated with a geographical distribution pattern. Florally, the variation resides in the color of the petals, from rose with a red inner base (RRIB) (Figure 2C, 2D) or yellow with red inner base (YRIB) (Figure 2E–2L) to yellow-orange with red inner base (YORIB) (Figure 3). In Mexico, the reported populations of this species are RRIB (Salazar Chávez and Soto Arenas 1996), while in

Guatemala, populations are either RRIB (as in the holotype) or YRIB but together within the same population. In several populations in Honduras, individuals are exclusively YRIB, as in Guatemalan populations. In the single known population in Nicaragua (Jinotega), petals are particularly striking for the YORIB, but the shape, size and color of the other segments of the flower are similar to populations of Guatemala and Honduras.

According to IUCN (2014) criteria and the Geospatial Conservation Assessment Tool “GeoCAT” (Bachman et al. 2011), *L. appendiculata* should be considered a Least Concern species because it is distributed over a large range (extent of occurrence: 163,599.9 km²). However, the area of occupancy using a 2 × 2-km cell grid is only 100 km² (cell width of 2 km), which suggests that Endangered may be appropriate for this species. *Lepanthes appendiculata* does have a large area of distribution from southwest Mexico to northern Nicaragua, usually growing as an epiphyte on the thick branches of high trees in lower montane subtropical rainforests, high evergreen forests, pine-oak-Liquidambar forests, and in cloud forests. However, in Mexico, Salazar Chávez and Soto Arenas (1996) gave the low number of plants and habitat destruction are the primary risk factors. In Guatemala, the wet forest and subtropical lower rainforest habitats where it commonly grows and are seriously threatened due to extensive conversion to agriculture (cultivation of corn, beans, tomatoes, potatoes, and chili). Other factors impacting the survival of this species are uncontrolled wildfires, incentives by the local forest department to replace native vegetation with *Pinus maximinoi* H.E. Moore, and rapid changes in land use due to extensive cattle ranching in the areas adjacent to the Guatemalan forests. In Honduras, protected populations are only within national parks and reserves, but outside of these areas other populations are unprotected and habitats are severely jeopardized by unmonitored wildfires and agricultural activities. In Nicaragua, *L. appendiculata* habitat overlaps with the local, highly lucrative coffee plantations. Coffee is the principal cash crop but other crops include hillside cabbage, lettuce and beans. Conversion of native habitat to these crops are impacting *L. appendiculata*. This species and other local orchids that grow on the stems and branches of the coffee plant or other trees are indiscriminately removed by scraping because coffee growers believe that orchids are parasitic and their elimination will boost coffee production. In light of these threats, we believe that *L. appendiculata* should be categorized as Endangered rather than Least Concern.

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APPENDICES

Appendix 1

Vouchers examined of *Lepanthes appendiculata* (based on material authors and studies cited in Table 1).

MEXICO. Chiapas: Mpio. Jaltenango, Reserva El Triunfo, Polígono 1, Cerro El Triunfo, 15°39' N, 092°48' W, 2100 m, montane rain forest, 21 November 1990, *M. Health & A. Long 1311* (AMO); E of Comitán, shore forests of Lake Tziscão, 1350 m, 1 February 1937, *O. Nagel & E. Monzón sub Östlund 6581* (US); Parque Nacional Lagunas de Montebello, Cinco Lagos, selva baja perennifolia de *Clusia* y *Podocarpus*, 1400 m, 9 August 1992, *M.A. Soto & R. Solano 7261* (AMO-Spirit). Oaxaca: Mpio. Sta. María Chimalapa, ca. de límite con el mpio. de San Miguel Chimalapa, Puerto de los Duendes, en filo entre Cerro el Quetzal (al NE) y Cerro Salomón (al S), 16°45'30" N, 094°11'30" W, 1800–1900 m, 22 June 1985, *T. Wendt et al. 5104* (CHAPA); Arroyo el Faisán al NO del Cerro Sabinal, Pico al SO del Cerro Guayabitos, ca. 4.5 km en línea recta al NE de Díaz Ordaz, ca. 40 km en línea recta al N de San Pedro Tapanatepec, Mpio. San Miguel Chimalapa, 16°44' N, 094°11' W, 1500 m, 8 August 1986, *S. Maya 3743* (CHAPA). **GUATEMALA.** Alta Verapaz: Samac, 20 October 1920, *H. Johnson 879* (AMES-holotype); San Cristóbal, Aldea Chituj, Bosque Pluvial Montano Bajo Subtropical, 1700 m, January 2012, *R. Hernández s.n.* (Figure 2B). Baja Verapaz: Purulha, Reserva Privada Ranchitos del Quetzal, Bosque Pluvial Montano Bajo Subtropical, 1600 m, July 2015, *J. Monzón Sierra s.n.* (Figure 2C-D). **EL SALVADOR.** [Morazán:] Perquín-Zancudo, 1800 m, *O. Pank-FH 201* (Hamer 1974). **HONDURAS.** Atlántida: Parque Nacional Pico Bonito, bosque nuboso latifoliado, 2251 m, 21 June 2012, *H. Vega 1099* (TEFH); Texiguat, bosque nuboso latifoliado, 1500 m, 28 July 2012, *P. House & H. Vega s.n.* (Figure 2E). Comayagua: Parque Nacional Cerro Azul Meámbar,

bosque nuboso latifoliado, 1150 m, 1 March 2012, *H. Vega s.n.* (Figure 2F). Francisco Morazán: Parque Nacional La Tigra, bosque nuboso latifoliado, 2121 m, 25 July 2010, *H. Vega s.n.* (Figure 2G); Reserva Biológica Misoco, bosque nuboso latifoliado, 2023 m, 24 July 2012, *H. Vega 1447* (TEFH, Figure 2H); El Chile, bosque nuboso latifoliado, 2083 m, 2 February 2013, *H. Vega s.n.* (Figure 2J). Intibucá: Opalaca, 2292 m, bosque nuboso latifoliado, 8 November 2013, *H. Vega 1907* (TEFH, Figure 2K). Lempira: Parque Nacional Montaña Celaque, bosque nuboso latifoliado, 2600 m, 8 May 2014, *H. Vega s.n.* (Figure 2I). Olancho: Sierra de Agalta, bosque nuboso latifoliado, 2019 m, 14 May 2012, *H. Vega s.n.* (TEFH-photo); El Armado, bosque nuboso latifoliado, 1803 m, 8 May 2013, *H. Vega & K. Romero 1798* (TEFH, Figure 2L). Santa Bárbara: Santa Bárbara: bosque nuboso latifoliado, 2227 m, 15 July 2015, *H. Vega s.n.* (TEFH-photo). **NICARAGUA.** Matagalpa: Reserva natural Cerro el Arenal, Finca El Suspiro, cordillera Dariense, 1300–1500 m, 1 August 2015, *N. Cash-Arcia 6* (HULE, Figure 3).

Appendix 2

Vouchers representatives for *Lepanthes* species from Nicaragua (based on studies cited in Table 1 and Tropicos 2015).

- 1) *L. acuminata* [*Stevens 11595-b* (MO); *Williams 24060* (MO)].
- 2) *L. blepharistes* [*Heller 9195*(SEL); *Moreno 19738* (MO); *Rueda 2562* (MO)].
- 3) *L. costaricensis* [*Stevens 22487* (MO); *Williams 27680* (F)].
- 4) *L. disticha* [*Moreno 16990, 20183* (MO)].
- 5) *L. edwardsii* [*Heller 8636* (SEL)].
- 6) *L. eximia* [*Heller 6384* (SEL); *Stevens 22559* (MO)].
- 7) *L. guanacastensis* [*Heller 2524, 6327* (SEL)].
- 8) *L. helleri* [*Moreno 16332* (MO); *Stevens 20467* (MO)].
- 9) *L. oreocharis* [*Heller 2900, 3085* (SEL)].
- 10) *L. turialvae* [*Webster et al. 12502* (DAV)].